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FINANCIAL FACTORS AND INVESTMENT IN BELGIUM, FRANCE, GERMANY AND THE UK: A COMPARISON USING COMPANY PANEL DATA

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Abstract

We construct company panel datasets for manufacturing firms in Belgium, France, Germany and the UK, covering the period 1978-89. These datasets are used to estimate a range of empirical investment equations, and to investigate the role played by financial factors in each country. A robust finding is that cash flow or profits terms appear to be both statistically and quantitatively more significant in the UK than in the three continental European countries. This is consistent with the suggestion that financial constraints on investment may be relatively severe in the more market-oriented UK financial system.

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1. Introduction

There is now a large microeconometric literature that investigates the role of financial factors in company investment decisions. Most studies find that financial variables such as cash flow help to explain investment spending. For some econometric models of investment, this relationship should not occur under the null hypothesis that company investment spending is not affected by financial constraints, and the evidence of excess sensitivity to cash flow is interpreted as suggesting the importance of such constraints. It is sometimes suggested that these financial constraints on investment may be the outcome of asymmetric information between firms and suppliers of finance. The excess sensitivity of investment to financial variables has been found to be less important for certain types of firms, such as those with close relationships to banks in Japan and Germany, and those which pay out high dividends in the UK and the US[1].

Once we move away from a model of perfect capital markets in which financial decisions and real investment decisions are separable, we raise the possibility that different financial systems may have different effects on company investment. Heterogeneity across countries has been well documented, for example in patterns of investment finance, corporate ownership patterns, corporate governance rules, the market for corporate control and the relative importance of different financial markets and institutions[2]. Differences between Anglo-American 'market-based' and German or Japanese 'bank-based' systems have received particular attention. It is sometimes suggested that the arms-length relation between firms and suppliers of finance that tends to characterise the market-oriented systems may be less effective at dealing with problems of asymmetric information. Perhaps surprisingly, there has been little investigation of whether these differences between financial systems may be related to differences in the impact of financial constraints on investment.

The aim of this paper is to begin an econometric investigation of this question. We construct company panel datasets for manufacturing firms in France, Germany, Belgium and the UK, covering the period 1978-1989. These datasets are used to estimate a range of empirical investment equations, and to investigate the role played by financial factors in each country. The main focus of the investigation is to compare results for the same investment model across different countries, rather than to compare 'competing' econometric specifications within each country. We therefore emphasise results that appear to be robust to the choice of model specification.

[1]See *inter alia* Hoshi, Kashyap and Scharfstein (1991), Elston (1993), Bond and Meghir (1994) and Fazzari, Hubbard and Petersen (1988).

[2]See *inter alia* Mayer (1988, 1990), and Edwards and Fischer (1994).

We estimate accelerator, error correction and Euler equation specifications, including additional cash flow and profits terms to investigate the role of financial variables. The models are estimated using GMM methods which control for unobserved firm-specific effects. Some OLS and Within Groups results are reported for comparison, and suggest the importance of controlling for firm-specific effects.

There are important differences between firms in these countries, and in the nature of the accounts data that were available for this study. The UK data refer to the consolidated accounts of company groups that are traded on the London Stock Exchange. The accounts data available for corporations in the other countries are generally not consolidated. The German data also refer only to stock market quoted firms. The data for France and Belgium cover a wider range of firms who report accounts in those countries, and include some unquoted companies as well as some subsidiaries of larger firms. As the proportion of corporate activity accounted for by firms quoted on national stock markets varies considerably across these countries, it would not necessarily be desirable to restrict attention only to quoted firms. However it would be desirable to have more comparable accounting data, on either a consolidated or unconsolidated basis. The impact of other differences between accounting rules in the four countries is minimised by using recorded cash flows wherever possible, and by estimating values for the capital stock from the investment flows on a standard basis for each sample.

Partly as a result of these differences in the data available, the UK and German companies we study tend to be larger than the French and Belgian companies[3]. Nevertheless we find that simple time series descriptions of the investment process display a remarkable degree of uniformity across the four datasets. But interesting differences between the four countries are found in the results of the econometric investment models. Financial variables are found to play an important role in France and the UK. Moreover a robust finding across all specifications is that cash flow or profits terms appear to be both statistically and quantitatively more significant in the UK than in the continental European countries. This result is consistent with the suggestion that financial constraints on investment may be relatively severe in the more market-oriented UK financial system.

The remainder of the paper is organised as follows. Section 2 briefly describes the three investment models that we estimate in this study; section 3 describes the four datasets we use; section 4 presents our empirical results; and section 5 concludes with a discussion of these findings.

[3]We use our largest sample of firms in France to investigate the impact of firm size on our results. We also consider a sub-sample of German companies for which consolidated data were available to investigate the impact of this accounting difference on our results.

2. Three empirical investment equations

We estimate three different econometric models of company investment, which allows us to consider the sensitivity of our empirical findings to the choice of model specification. The models we use are an accelerator model, an error correction model, and an Euler equation. These are described in the next three sections.

2.1. An accelerator specification

Accelerator models of investment can take many forms. We start from the assumption that, in the absence of adjustment costs, the desired capital stock can be written as a log-linear function of output and the cost of capital. Letting k_{it} denote the (natural) log of the desired capital stock for firm i in period t, y_{it} denote the log of output and j_{it} denote the log of the user cost of capital, we write the desired capital stock as

$$k_{it} = a + y_{it} - \sigma j_{it}. \tag{2.1}$$

This is consistent with profit maximisation subject to constant returns to scale and a CES production function, and nests the possibility of a fixed capital-output ratio ($\sigma = 0$). Taking first differences and using the approximation $\Delta k_{it} \approx I_{it}/K_{i,t-1} - \delta$, where I_{it} is investment and K_{it} is the capital stock at the end of period t, then gives the basic investment equation

$$\frac{I_{it}}{K_{i,t-1}} = \delta + \Delta y_{it} - \sigma \Delta j_{it}. \tag{2.2}$$

To account for slow adjustment of the actual capital stock to the desired capital stock, we nest this within a general dynamic regression model. We also assume that variation in the user cost of capital can be controlled for by including both time-specific and firm-specific effects. The model we estimate therefore has the form

$$\frac{I_{it}}{K_{i,t-1}} = \rho\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \beta_0 \Delta y_{it} + \beta_1 \Delta y_{i,t-1} + d_t + \eta_i + v_{it} \tag{2.3}$$

where d_t is a time dummy, η_i is an unobserved firm-specific effect and v_{it} is an error term. The final specification we report is obtained by omitting insignificant terms from a general dynamic model.

Several points can be noted briefly about this model. The lagged dependent variable will be correlated with firm-specific effects. Growth in output may also be correlated with these effects, and the current change in output is likely to be correlated with shocks to investment via the production function. We allow for this endogeneity in estimation. If constant returns to scale is acceptable, the long run effect of output growth on the investment rate ($[\beta_0 + \beta_1]/[1 - \rho]$) should be unity. Finally we emphasise that the interpretation of additional cash flow or profits terms added to the right-hand side of equation (2.3) is ambiguous. Whilst a significant cash flow effect could reflect the presence of financial constraints on investment, it is also possible that such terms would be significant in the absence of financial constraints. In the presence of adjustment costs, for example, current investment depends not only on current but also on expected future changes in the desired stock of capital[4]. It is possible that information on cash flow helps to forecast output, for example, in which case such information on cash flow would help to explain investment spending. By the presence of financial constraints on investment, we mean a situation where a windfall increase in profits, that conveyed no new information about future profitability or investment opportunities, would nevertheless be associated with a rise in investment spending. This concept of financial *constraints* on investment should be distinguished from the possibility of significant *effects* from financial variables in empirical investment models that do not otherwise control for expectational influences.

2.2. An error correction specification

An alternative approach, rather than taking first differences of equation (2.1), is to nest equation (2.1) itself within a dynamic regression model. This approach was used in the investment literature by Bean (1981), and has the advantage of retaining information in the levels of output and the capital stock.

Following Bean (1981), we consider an error correction specification which has equation (2.1) as its long-run solution. Again dropping terms in the user cost of capital, and using the approximation $\Delta k_{it} \approx I_{it}/K_{i,t-1} - \delta$, this gives an empirical model of the form

$$\frac{I_{it}}{K_{i,t-1}} = \rho\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \beta_0 \Delta y_{it} + \beta_1 \Delta y_{i,t-1} + \phi(k_{i,t-2} - y_{i,t-2}) + d_t + \eta_i + v_{it}. \quad (2.4)$$

It is noteworthy that this nests the accelerator model considered in the previous section. However the long-run properties of this model depend only on the form of the error correction mechanism $(k_{i,t-2} - y_{i,t-2})$, and not on the parameters β_0, β_1 and ρ. The proportionality imposed in equation (2.4) depends on the assumption of constant returns to scale, which can be tested by including an additional term in $y_{i,t-2}$ (or $k_{i,t-2}$). 'Error correcting' behaviour requires that $\phi < 0$, so that a capital stock above its desired level is associated with lower future investment, and *vice versa*. The interpretation of additional financial variables as reflecting influences on expectations rather than financial constraints again remains a possibility with this type of model.

[4]See Nickell (1978), chapter 11, for example.

2.3. An Euler equation specification

The version of the Euler equation model we estimate is based on Bond and Meghir (1994). This is a structural relation between investment rates in successive periods, derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. Under this assumption, the Euler equation model has the advantage of controlling for all expectational influences on the investment decision. Evidence of mis-specification associated with the role of financial variables in this model is less easily explained away as merely capturing an expectational influence[5].

The firm is assumed to maximise the present discounted value of current and future net cash flows. Letting L_{it} denote variable factor inputs, w_{it} the price of variable factors, p^I_{it} the price of investment goods, p_{it} the price of output, β^t_{t+j} the nominal discount factor between period t and period t+j, δ the rate of depreciation, $F(K_{it}, L_{it})$ the production function gross of adjustment costs, $G(I_{it}, K_{it})$ the adjustment cost function and $E_t(.)$ the expectations operator conditional on information available in period t, the firm solves

$$\max E_t \left[\sum_{j=0}^{\infty} \beta^t_{t+j} R(K_{i,t+j}, L_{i,t+j}, I_{i,t+j}) \right] \tag{2.5}$$

$$\text{s.t. } K_{it} = (1-\delta)K_{i,t-1} + I_{it}$$

$$\text{where } R_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it} - p^I_{it}I_{it}.$$

The Euler equation characterising the optimal investment path relates marginal adjustment costs in adjacent periods. This can be written as

$$-\left(\frac{\partial R}{\partial I}\right)_{it} = -(1-\delta)\beta^t_{t+1}E_t\left(\frac{\partial R}{\partial I}\right)_{i,t+1} + \left(\frac{\partial R}{\partial K}\right)_{it}. \tag{2.6}$$

Assuming competitive markets and that $F(K_{it}, L_{it})$ is constant returns to scale, and specifying $G(I_{it}, K_{it}) = \frac{b}{2}[(I/K)_{it} - c]^2 K_{it}$, this can be expressed as

$$\left(\frac{I}{K}\right)_{it} - \alpha_1\left(\frac{I}{K}\right)^2_{it} = \alpha_2 E_t\left(\frac{I}{K}\right)_{i,t+1} + \alpha_3\left[\left(\frac{\Pi}{K}\right)_{it} - J_{it}\right] \tag{2.7}$$

$$\text{where } \Pi_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it}$$

is gross operating profit and J_{it} is the user cost of capital. Current investment is positively related to expected investment and to the current average profits term (reflecting the marginal profitability of capital under constant returns), and

[5]The same comment applies to the Q model. We do not consider a Q model here as we wish to include unquoted companies in our samples.

negatively related to the user cost of capital. An attractive feature of the Euler equation model is that all relevant expectational influences are captured by the one step ahead investment forecast.

To implement this model, we replace the unobserved $E_t\left(I/K\right)_{i,t+1}$ by the realised $(I/K)_{i,t+1}$ plus a forecast error, and take this $(I/K)_{i,t+1}$ term to the left-hand side to obtain an econometric model that is linear in variables. We also replace the cost of capital term by time effects and firm-specific effects, and include a term in the output-capital ratio that may be introduced either by non-constant returns to scale or by monopolistic competition in the product market. The resulting empirical specification is

$$\left(\frac{I}{K}\right)_{i,t+1} = \beta_1\left(\frac{I}{K}\right)_{it} - \beta_2\left(\frac{I}{K}\right)^2_{it} - \beta_3\left(\frac{\Pi}{K}\right)_{it} + \beta_4\left(\frac{Y}{K}\right)_{it} + d_{t+1} + \eta_i + v_{i,t+1}. \quad (2.8)$$

Unlike the previous two models, this Euler equation model should control for the influence of financial variables on expectations of future profitability. Under the null of no financial constraints, it can be shown that $\beta_1 \geq 1$, $\beta_2 \geq 1$, $\beta_3 > 0$ and (under constant returns to scale) $\beta_4 \geq 0$. Under the alternative, investment spending is positively related to cash flow or profits through the effect of financial constraints. The basic Euler equation in (2.8) is then mis-specified. Since the gross operating profits term $(\Pi/K)_{it}$ in equation (2.8) will be highly correlated with cash flow, the prediction of a negative sign on this term may be expected to fail in the presence of financial constraints.

The main aim of our study is to investigate whether robust results are obtained across countries from each of these models, not to evaluate them as rival specifications. It would not make sense to compare a structural dynamic model like the Euler equation with empirically derived models in terms of goodness of fit. Moreover, the validity of these models is not mutually exclusive. The Euler equation is not inconsistent with the CES assumption used to obtain the error correction model; and the error correction model is not incompatible with the assumption of symmetric, quadratic adjustment costs[6].

3. Data

We use panel data on company accounts covering the period 1978-89. All firms have their main activity in the manufacturing sector, and firms with fewer than 100 employees in their first year in our sample were excluded. Firms that had engaged in major merger or acquisition activity were also excluded wherever possible, as the standard models of investment may not characterise these discrete adjustments very well.

[6]See Nickell (1985) for further discussion of the links between adjustment costs and error correction models.

The UK sample comprises 571 firms quoted on the London Stock Exchange for which consolidated accounts data were available from Datastream. Some of these companies have branches and subsidiaries overseas whose activities will be included in this data. The French and Belgian samples comprise 1,365 firms and 361 firms respectively, for which unconsolidated accounts data have been collected by INSEE in France and the central bank in Belgium. These need not be stock market quoted companies, and may include subsidiaries of foreign companies. In principle, the investment of French or Belgian subsidiaries of UK companies could appear in both samples, although this is unlikely to be very common. The German sample comprises some 228 Aktiengesellschaft (AG) corporations, for which unconsolidated accounts data were available from the Bonn Data Bank. This contains most of the manufacturing AG firms for which sufficient years of data were available, and accounts for a large proportion of the German manufacturing sector.

The main variables we use are flows of investment, sales and gross operating profits. Investment spending, net of disposals, is obtained from the sources and uses of funds account, and not inferred from changes in the balance sheet. We construct a measure of cash flow by adding back reported depreciation to reported profits net of interest and taxes. We use sales as a proxy for output. For the French and Belgian data a measure of value added was available from the company accounts. Experiments showed that very similar results were obtained when this was used in place of sales.

A measure of the stock of capital at current replacement cost was estimated from the flow data on investment using a standard perpetual inventory method for each sample. The starting value was based on the net book value of tangible fixed capital assets, adjusted for previous years inflation. Subsequent values were obtained using accounts data on investment and disposals, national price indices for investment goods prices, and a depreciation rate of 8% assumed to be common to all countries. Further details of this calculation can be found in the data appendix.

Table 1 presents some basic features of these datasets. The size distribution of all the samples is highly skewed, with mean employment being 2-7 times higher than median employment. The UK and German firms are clearly much larger on average than those in our French and Belgian samples, and the former samples are also more skewed. The French and Belgian firms had similar employment levels on average in 1985, but the French sample is more skewed and contains some much larger firms than the Belgian sample. We investigate the impact of firm size on our results by considering a sub-sample of the French firms whose employment was over 1000 in the first year of observation.

The average growth of real sales, investment and capital between 1978 and 1989 was quite similar for our French and UK samples. However growth was considerably faster on average in our sample of Belgian firms, and lower in our sample of German firms (***CONFIRM OR REVISE***). Table 2 reports the mean values of the variables used in our econometric analysis. The investment rates appear very similar on average in these datasets. The capital-output ratio is higher on average in our UK sample, which may in part reflect the netting out of intra-group sales in these consolidated accounts. We investigate the impact of consolidation on our results by considering a sub-sample of the German firms for which consolidated accounts were available.

4. Empirical results

We begin our empirical investigation by reporting some simple time series descriptions of the investment process in each of our samples. Table 3 reports the results of estimating an AR(2) model for the investment rate $(I_{it}/K_{i,t-1})$. In each case we report the results from three estimators: OLS levels, Within Groups, and GMM first differences[7]. OLS levels does not control for the possibility of unobserved firm-specific effects and may therefore result in upward-biased estimates of the autoregressive coefficients if firm-specific effects are important. Within Groups is OLS after transforming the data to deviations from firm means; this eliminates the firm-specific effects but is well known to result in downward-biased estimates of the autoregressive coefficients in panels with a small number of time periods[8]. GMM first differences eliminates the firm-specific effects by differencing the equations, and then uses lagged values of endogenous variables as instruments. If the error term in levels is serially uncorrelated, then the error term in first differences is MA(1), and instruments dated t-2 and earlier should be valid in the differenced equations. Under this assumption, consistent parameter estimates can be obtained. If the error term in levels is itself MA(1), then only instruments dated t-3 and earlier will be valid; and so on. We test the validity of the instruments used by reporting both a Sargan test of the over-identifying restrictions, and direct tests of serial correlation in the residuals[9].

Despite the differences between these samples discussed in the previous section, the investment dynamics display a striking degree of similarity. In all cases the OLS levels results appear to be significantly biased upwards relative to the GMM results, and the Within Groups results appear to be significantly biased downwards. This suggests the presence of significant firm-specific effects, so we focus on the GMM results. The instruments used were lagged values of (I/K) dated t-2, t-3, ... , t-7 (where available), and year dummies were included in the specification. The validity of these instruments is easily accepted for two of the

[7] All standard errors reported in parentheses are asymptotically robust to heteroskedasticity.

[8] See Nickell (1981).

[9] See Arellano and Bond (1991) for further details of these procedures, which were implemented using GAUSS and the DPD program (see Arellano and Bond, 1988).

four countries, though is marginal for Belgium and the UK[10]. The investment rate data seems to be described fairly well by this simple AR(2) process, with significant positive autocorrelation in all cases. The sum of the coefficients on the two lagged terms varies between 0.21 for the UK and 0.26 for Germany.

Table 4 reports GMM results for a basic accelerator model of the form outlined in equation (2.3), with additional terms in the ratio of cash flow to the beginning of period capital stock ($C_{it}/K_{i,t-1}$) included to test the basic specification. The instruments used were the lagged values of all right-hand side variables dated t-2, t-3, ..., t-7, which allows for contemporaneous correlation between these variables and shocks to the investment equation, as well as correlation with unobserved firm-specific effects[11]. Comparison to OLS and Within Groups estimates again indicated the presence of significant firm-specific effects. In all cases we find significant positive effects from the lagged dependent variable and (except Germany) from the growth in sales. Perhaps more interestingly, we find a significant positive effect from either current or lagged cash flow in all cases. Moreover, the sensitivity of investment spending to cash flow appears to be much greater in the UK than in the other three countries.

Table 5 reports corresponding GMM results for an error correction model of the form outlined in equation (2.4), without imposing the restriction of constant returns to scale. The inclusion of the error correction term reduces the significance of the lagged dependent variable and the cash flow terms. For our German and Belgian samples, we find no statistically significant effect of cash flow on investment in this specification. It is also noticeable, and perhaps not unrelated, that for these two samples we do not reject the constant returns to scale restriction. For our French and UK samples we do find significant cash flow effects, and again it is striking that the sensitivity of investment to cash flow appears to be much greater for the UK companies.

Table 6 reports GMM estimates for the Euler equation specification used by Bond and Meghir (1994) and set out in equation (2.8). The instrument set used here includes instruments dated t-2, which were found to be invalid in UK data by Bond and Meghir (1994). The coefficients on the lagged investment terms are correctly signed, but much smaller in absolute value than suggested by the derivation of this model in the absence of financial constraints on investment. The coefficient on the gross operating profits term is positive in all cases, and significantly different from zero for France and the UK, which is again contrary to the theoretical prediction under the null of no financial constraints. This effect

[10] In the tables we report p-values for the Sargan test (i.e. the probability of generating the calculated Sargan statistic under the null of valid instruments), which is asymptotically distributed as χ^2. We report actual values for the tests of first order (m1) and second order (m2) serial correlation in the differenced residuals. These are asymptotically standard normal under the null of no serial correlation.

[11] i.e. both current sales and current cash flow are treated as potentially endogenous variables in the investment equation.

is also much stronger in the UK sample. These results are very similar to those obtained using t-2 instruments by Bond and Meghir (1994).

In Table 7 we report GMM estimates of the Euler equation model using only instruments dated t-3 and earlier. The exclusion of instruments dated t-2 substantially reduces the precision of the parameter estimates. In our smallest sample, for Germany, we then fail to identify any significant investment dynamics. In the three other samples the coefficients on the lagged investment terms increase in absolute value towards the values that should characterise the adjustment of capital in the convex adjustment costs model. For France and Belgium, the coefficient on gross operating profits is not significantly positive in these results, and the Sargan statistic does not suggest serious mis-specification. For the UK, however, the positive coefficient on the profits term remains highly significant, and even the t-3 instrument set is rejected by the Sargan test[12].

For each of the investment models we have considered, the cash flow or profits variables appear to play a more important role in our sample of UK firms than in the remaining countries. Although our UK sample contains much larger firms than our French and Belgian samples, and some previous studies have found stronger evidence of financial effects on investment among larger firms[13], we can be reasonably confident that this finding is not driven by differences in firm size. First, the size distribution of firms in our German sample is quite similar to that in our UK sample (see Table 1), but we find much weaker effects from financial variables in our German results. Secondly, we used our large sample of French companies to investigate the impact of firm size directly. The results of estimating each of the investment models on a sub-sample of 234 large French firms are reported in the results appendix. These firms had at least 1000 employees in their first year in our sample: mean employment in 1985 was 3,819, and median employment was 1,794. However the results for this sub-sample show almost no significant differences from our results for the full French dataset, and these is no indication that these larger French firms are more (or less) affected by financial constraints.

Finally we investigated the impact of using consolidated or unconsolidated accounts data on our results. Recall that our data for the UK - where we have found the strongest effects from cash flow - are consolidated accounts for company groups, whilst our data for the remaining countries are unconsolidated accounts. Clearly there is a possibility that the investment spending by a subsidiary is constrained by the cash flow of the company group as a whole, rather than by the cash flow of the subsidiary itself, and that this will not be detected by regressing the subsidiary's investment on its own cash flow using unconsolidated data. Notice that in this case we would be underestimating the impact of financial

[12]As would be expected in the presence of significant financial constraints on investment spending, when this model is indeed mis-specified.

[13]See Devereux and Schiantarelli (1990).

constraints in France, Germany and Belgium, rather than overestimating the importance of financial constraints in the UK.

To investigate this possibility we used a sub-sample of 87 German companies for which consolidated company accounts were also available in the Bonn Data Bank. Mean and median employment in 1985 for this sub-sample were 37,317 and 7,669 respectively, so these firms are also much larger on average than in any of the other samples we have used. The results of estimating our four investment equations on this sub-sample are also reported in the results appendix. For the simple accelerator model, the coefficient on cash flow is indeed higher in this sample of consolidated German accounts. However this result is not robust across specifications. In the error correction model there is no significant effect from cash flow in the consolidated German data, and the results for the Euler equation models are similar to those found using the unconsolidated German data. This comparison does not suggest that the differences between our results for the UK and for France, Germany and Belgium are primarily driven by this difference in the level of aggregation at which the company data is available, although it would be interesting to investigate this issue further with larger samples.

5. Conclusions

A consistent pattern emerges from our results. Simple accelerator specifications tend to exaggerate the importance of financial variables in investment equations, with cash flow measures proxying for omitted error correction terms. Nevertheless we did find evidence of (excess) sensitivity of company investment spending to cash flow in both France and the UK, using error correction and Euler equation specifications. A robust result across all our specifications is that the sensitivity of investment to financial variables was both statistically and quantitatively more significant in the UK than in France, Germany or Belgium. This difference was not explained by differences in the size distribution of firms or in the nature of the company accounts data available for the UK.

The significance of cash flow terms in the accelerator and error correction models could in principle reflect expectations-formation rather than financial constraints, although if this is the correct interpretation it is perhaps surprising that we observe substantial differences between countries. This interpretation is also less appealing in the context of the Euler equation model, where the model derived under the null of no financial constraints is clearly rejected for the UK sample. Previous research using UK data also indicates that this excess sensitivity of investment to cash flow is concentrated among observations on low-dividend paying companies, which is consistent with the presence of relatively severe financial constraints on investment spending for these firms[14].

[14]See Bond and Meghir (1994).

The availability of internal finance appears to have been a more important constraint on company investment in our sample of UK firms than in our samples of continental European firms over the period 1978-89. This finding is consistent with the suggestion that the market-oriented financial system in the UK performs less well in channelling investment funds to firms with profitable investment opportunities than do the continental European financial systems. However we would caution that we have not tested this hypothesis directly, and our results are doubtless consistent with other interpretations. The accounts data available for this study were not as consistent across countries as we would have liked. Moreover, models of financial constraints predict that investment is only constrained when desired investment exceeds the supply of internal finance; it may simply be that our results reflect transient differences in the frequency of this event within our samples, rather than deeper differences in the effects of different financial systems. Discriminating between these alternative interpretations will require more detailed comparative analyses of the investment behaviour of different types of companies across countries; we believe this to be an important challenge for future research.

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Table 1: Some basic features of the datasets

Size of the Samples (1978-89)

	France	Belgium	UK	Germany
Firms	1365	361	571	228
Observations	13580	3654	(5742)	(2466)

Employment in 1985

	France	Belgium	UK	Germany
Mean	939	777	6342	6944
Std. Dev.	3838	1300	21117	22215
Q25	180	231	394	425
Median	332	399	983	980
Q75	659	732	3261	2991
Max	91049	11670	312000	202200

Average annual growth, *per cent* (1978-89)

	France	Belgium	UK	Germany
Real sales	1.5	4.3	2.6	(1.1)
Real capital	3.1	3.9	(3.4)	4.5
Real investment	3.4	6.9	(3.6)	(0.9)

Table 2: Means (standard deviations) of variables used in estimation

	France	Belgium	UK	Germany
$\left(\frac{I_t}{K_{t-1}}\right)$	0.110 (.089)	0.125 (.107)	0.117 (.110)	0.122 (.079)
Δy_t	0.010 (.125)	0.027 (.145)	0.033 (.177)	0.005 (.143)
$(k-y)_{t-2}$	-0.926 (.546)	-0.993 (.612)	-0.684 (.520)	-0.876 (.577)
$\left(\frac{C_t}{K_{t-1}}\right)$	0.116 (.132)	0.169 (.136)	0.134 (.106)	0.160 (.093)
$\left(\frac{I_{t-1}}{K_{t-1}}\right)$	0.103 (.067)	0.111 (.076)	0.102 (.073)	0.117 (.061)
$\left(\frac{I_{t-1}}{K_{t-1}}\right)^2$	0.021 (.047)	0.027 (.064)	0.016 (.027)	0.017 (.020)
$\left(\frac{\Pi_{t-1}}{K_{t-1}}\right)$	0.224 (.168)	0.225 (.149)	0.195 (.131)	0.223 (.117)
$\left(\frac{Y_{t-1}}{K_{t-1}}\right)$	2.868 (1.665)	3.247 (2.195)	2.186 (1.260)	2.578 (1.260)

Table 3: AR(2) models for I_t/K_{t-1}

OLS levels

	France	Belgium	UK	Germany
ρ_1	.3152 (.0176)	.2994 (.0327)	.3283 (.0279)	.3713 (.0398)
ρ_2	.1376 (.0126)	.0488 (.0253)	.1274 (.0213)	.0511 (.0308)

Within Groups

	France	Belgium	UK	Germany
ρ_1	.0998 (.0175)	.1115 (.0333)	.1032 (.0271)	.1927 (.0406)
ρ_2	-0.0672 (.0130)	-0.1344 (.0272)	-0.0911 (.0231)	-0.1197 (.0318)

GMM first differences, t-2 instruments

	France	Belgium	UK	Germany
ρ_1	.2043 (.0221)	.2568 (.0467)	.1979 (.0482)	.2909 (.0575)
ρ_2	0.0226 (.0156)	-0.0139 (.0343)	0.0158 (.0303)	-0.0347 (.0493)
m1	-13.29	-7.41	-7.56	-6.92
m2	-1.54	0.60	-2.69	-1.07
Sargan	0.691	0.048	0.038	0.767

Table 4: Accelerator models

GMM first differences, t-2 instruments

	France	Belgium	UK	Germany
$\left(\frac{I_{t-1}}{K_{t-2}}\right)$	0.1592	0.2042	0.0862	0.2215
	(.0212)	(.0397)	(.0403)	(.0540)
Δy_t	0.1344	0.1111	0.1319	-0.0459
	(.0501)	(.0718)	(.0669)	(.0429)
Δy_{t-1}	0.0153	0.0509	-0.0054	0.0033
	(.0092)	(.0190)	(.0113)	(.0137)
$\left(\frac{C_t}{K_{t-1}}\right)$	0.0045	-0.0507	0.5726	0.2922
	(.0748)	(.0987)	(.1815)	(.0839)
$\left(\frac{C_{t-1}}{K_{t-2}}\right)$	0.1132	0.1566	-0.0239	0.0252
	(.0334)	(.0612)	(.1211)	(.0436)
m1	-13.30	-7.29	-9.11	-5.49
m2	-0.86	-0.13	-1.10	-1.33
Sargan	.298	.612	.065	.638

Table 5: Error correction models

GMM first differences, t-2 instruments

	France	Belgium	UK	Germany
$\left(\frac{I_{t-1}}{K_{t-2}}\right)$	-0.0088	-0.0189	-0.0745	0.0315
	(.0335)	(.0557)	(.0541)	(.0852)
Δy_t	0.0971	0.1706	0.1212	0.0380
	(.0489)	(.0780)	(.0611)	(.0296)
Δy_{t-1}	0.0113	0.1972	-0.0160	0.1182
	(.0431)	(.0611)	(.0356)	(.0376)
$(k-y)_{t-2}$	-0.1219	-0.2314	-0.1297	-0.1870
	(.0233)	(.0485)	(.0426)	(.0385)
y_{t-2}	-0.1096	-0.0525	-0.1187	-0.0576
	(.0365)	(.0523)	(.0324)	(.0299)
$\left(\frac{C_t}{K_{t-1}}\right)$	-0.0499	-0.0652	0.4583	0.0267
	(.0649)	(.0846)	(.1653)	(.0485)
$\left(\frac{C_{t-1}}{K_{t-2}}\right)$	0.0742	0.0658	-0.0502	-0.0491
	(.0274)	(.0523)	(.1160)	(.0315)
m1	-11.66	-6.83	-7.55	-6.55
m2	-1.42	-0.09	-1.44	-2.05
Sargan	.074	.488	.386	.475

Table 6: Euler equation models

GMM first differences, t-2 instruments

	France	Belgium	UK	Germany
$\left(\frac{I}{K}\right)_{t-1}$	0.3658 (.0399)	0.4319 (.0909)	0.4922 (.0712)	0.4445 (.0943)
$\left(\frac{I}{K}\right)^2_{t-1}$	-0.4630 (.1069)	-0.4800 (.2446)	-0.8183 (.1698)	-0.4642 (.2496)
$\left(\frac{\Pi}{K}\right)_{t-1}$	0.0592 (.0122)	0.0014 (.0337)	0.1988 (.0318)	0.0230 (.0267)
$\left(\frac{Y}{K}\right)_{t-1}$	0.0090 (.0030)	0.0239 (.0054)	-0.0015 (.0050)	0.0135 (.0049)
m1	-17.92	-9.81	-11.82	-7.90
m2	-0.09	0.22	-1.30	-1.61
Sargan	.346	.214	.033	.328

Table 7: Euler equation models

GMM first differences, t-3 instruments

	France	Belgium	UK	Germany
$\left(\frac{I}{K}\right)_{t-1}$	0.5965	0.5252	0.7675	0.1290
	(.1393)	(.3119)	(.2592)	(.2925)
$\left(\frac{I}{K}\right)^2_{t-1}$	-1.3082	-1.1107	-1.8547	-0.3719
	(.4147)	(.9395)	(.6703)	(.7748)
$\left(\frac{\Pi}{K}\right)_{t-1}$	0.0409	0.0173	0.1025	0.1025
	(.0240)	(.0616)	(.0584)	(.0584)
$\left(\frac{Y}{K}\right)_{t-1}$	0.0159	0.0263	0.0061	0.0061
	(.0053)	(.0079)	(.0068)	(.0068)
m1	-7.96	-4.72	-5.11	-3.24
m2	-0.53	-0.85	-1.85	-2.57
Sargan	.241	.317	.056	.509

DATA APPENDIX

The company datasets for the four countries are obtained from different sources. For France, we obtain data on large and medium-sized firms from INSEE, which collects them from fiscal sources of the Ministry of Finance. Therefore these French data are the unconsolidated accounts of these corporations. For Belgium, we have access to the unconsolidated balance sheets and income accounts of a selected sample of large and medium-sized Belgian corporations. This sample has been built by the Banque National of Belgium, which collects the data from the Commerce Court. In fact, by law, all Belgian firms must register their annual accounts that are sent to the National Bank of Belgium. These French and Belgian companies need not be stock market quoted, and may include subsidiaries of foreign companies.

The UK sample comprises the consolidated accounts of companies quoted on the London Stock Exchange, which were obtained from Datastream. Finally, the German data has been collected at the University of Bonn. This contains basically all the manufacturing Aktiengesellschaft (AG) corporations for which sufficient years of data were available. These firms are also all quoted on the Frankfurt Stock Exchange, but the data available are unconsolidated accounts for these corporations[15].

We use panel data on company accounts covering the period 1978-89, even though for the UK and Germany longer time series were available. All firms have their main activity in the manufacturing sector, and firms with fewer than 100 employees in the first year of observation were excluded. The initial samples of firms which satisfied these requirements were 1473 firms for France, 410 firms for Belgium, 600 firms for the UK and 287 firms for Germany.

We attempted to use variables that are reasonably comparable across countries, even though the national accounting definitions are not precisely the same. The French and Belgian accounts have very similar definitions of the main variables. The UK and German accounts provide more limited information on costs, and the UK accounts report commercial depreciation rather than fiscal depreciation.

The main variables we use are flows of investment, sales, gross operating profits, and cash flow. Investment spending, net of disposals, is obtained from the sources and uses of funds account, and not inferred from changes in the balance sheet. We use sales as a proxy for output. For the French and Belgian data, a measure of value added was also available from the accounts. All the flow variables were deflated using output price indices at the sectoral level.

[15] For example Audi, which is an almost wholly owned subsidiary of Volkswagen, nevertheless has a separate listing.

A measure of the stock of capital at current replacement cost $P_t^I K_t$ was estimated from the flow data on investment I_t using a standard perpetual inventory method, in a similar way for each sample:

$$P_t^I K_t = (1-\delta)\, P_{t-1}^I K_{t-1} \left(\frac{P_t^I}{P_{t-1}^I} \right) + P_t^I I_t$$

$$\text{where : } \begin{cases} K_t & : \text{Capital Stock} \\ P_t^I & : \text{Price of Investment Goods} \\ I_t & : \text{Real Investment} \\ \delta & : \text{Depreciation rate (8\%)} \end{cases}$$

The starting value was based on the net book value of tangible fixed capital assets in the first observation within our sample period, adjusted for previous years inflation. For France, Belgium and Germany, where the reported net book value of assets subtracts the fiscal depreciation allowed for tax purposes rather than commercial depreciation, we have corrected this measure by taking into account accelerated fiscal depreciation. This correction lowers the value of accumulated depreciation, and thus increases the net book value of assets. Subsequent values were obtained using accounts data on investment and disposals, national price indices for investment goods prices, and a depreciation rate of 8% assumed to be common to all countries.

For France and Belgium, we construct a measure of gross operating profits Π by subtracting the total wage bill from value added. The measure of cash flow C is then computed from gross operating profits by subtracting payments of interest and taxes. This method was not possible for the UK and Germany, because we do not have data on value added. In these cases we computed cash flow by adding back reported depreciation to reported profits (net of interest and taxes). Gross operating profits were then obtained by adding back interest payments and taxes to this measure of cash flow.

After computing the main variables used in the investment models, we have excluded observations where the change in sales suggested that a major merger or acquisition (or disposal) had occurred, since it is not clear that such large adjustments would be well characterised by the usual investment models. We also excluded observations which appeared to contain substantial outliers. Specifically, observations were discarded if the investment rate exceeded one, if real sales increased or decreased by more than a factor of three, or if the observed ratio of either sales, gross operating profits or cash flow to the capital stock fell in the first or the last centile of the empirical distribution for each country. In these cases we retained the longest available time series of consecutive annual observations for the firms affected. We also required that at least six consecutive annual observations were available for the firms included in our final samples. These criteria resulted in a loss of respectively 7.3%, 11.9%, 5.0% and 21.3% of our initial observations for France, Belgium, the U.K. and Germany.

RESULTS APPENDIX

Table A1: Accelerator and error correction models

GMM first differences, t-2 instruments

	France Large Firms	France Large Firms	Germany Consolidated	Germany Consolidated
$\left(\frac{I_{t-1}}{K_{t-2}}\right)$	0.1435 (.0695)	-0.0054 (.0650)	0.0659 (.0540)	-0.3001 (.0746)
Δy_t	0.1776 (.0528)	0.1593 (.0613)	-0.0849 (.0577)	-0.0051 (.0425)
Δy_{t-1}	-0.0419 (.0092)	-0.0198 (.0458)	0.0350 (.0315)	0.0616 (.0329)
$(k-y)_{t-2}$	-	-0.1141 (.0322)	-	-0.2401 (.0494)
y_{t-2}	-	-0.0798 (.0388)	-	-0.1594 (.0400)
$\left(\frac{C_t}{K_{t-1}}\right)$	-0.0260 (.0706)	-0.0423 (.0678)	0.5499 (.1387)	0.1214 (.1127)
$\left(\frac{C_{t-1}}{K_{t-2}}\right)$	0.1194 (.0533)	0.1033 (.0497)	-0.0959 (.0841)	-0.0684 (.0715)
m1	-4.98	-4.88	-3.93	-4.48
m2	0.79	0.75	1.11	0.21
Sargan	.571	.266		

Table A2: Euler equation models

GMM first differences

	France Large Firms t-2 instruments	France Large Firms t-3 instruments	Germany Consolidated t-2 instruments	Germany Consolidated t-3 instruments
$\left(\frac{I}{K}\right)_{t-1}$	0.5633	0.8516	0.3000	0.2852
	(.0926)	(.2460)	(.1080)	(.1886)
$\left(\frac{I}{K}\right)^2_{t-1}$	-0.8427	-1.6878	-0.5468	-0.7429
	(.2476)	(.7905)	(.2802)	(.5191)
$\left(\frac{\Pi}{K}\right)_{t-1}$	0.0915	0.0474	-0.0125	-0.0004
	(.0240)	(.0361)	(.0522)	(.0718)
$\left(\frac{Y}{K}\right)_{t-1}$	-0.0053	-0.0001	0.0312	0.0376
	(.0046)	(.0088)	(.0091)	(.0125)
m1	-6.90	-4.68	-4.90	-3.99
m2	1.54	1.00	0.85	-0.14
Sargan	.379	.028		